

**WHAT IS CLAIMED IS:**

1. A metal complex-protein composite, comprising a protein having a cavity therein and a metal complex  
5 prepared by complexation of a metal ion, which is selected among the group consisting of rhodium, ruthenium, and palladium, with a ligand, said metal complex-protein composite having a specific structure that the metal complex is received in the cavity of the protein.

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2. A metal complex-protein composite in accordance with claim 1, wherein the protein is any one of proteins having either of an amino acid residue that coordinates to the selected metal ion of the metal complex and an amino  
15 acid residue that forms a non-covalent bond to the ligand of the metal complex in the cavity thereof, multimers of such proteins, and variants of such proteins.

3. A metal complex-protein composite in accordance  
20 with claim 1, wherein the protein is any one of proteins having the cavity in a heme site by removing a heme from heme-containing proteins, multimers of such proteins, and variants of such proteins.

4. A metal complex-protein composite in accordance with claim 1, wherein the protein is selected among the group consisting of apomyoglobin, apohemoglobin, apoheme  
5 oxygenase, apocatalase, apocytochrome, apoferritin, and their variants.

5. A metal complex-protein composite in accordance with claim 4, wherein the protein is an apomyoglobin  
10 variant having a replacement of histidine as a 64<sup>th</sup> amino acid residue of apomyoglobin.

6. A metal complex-protein composite in accordance with claim 1, wherein the metal complex is a complex of  
15 rhodium with a compound having a phosphino group as the ligand.

7. A metal complex-protein composite in accordance with claim 6, wherein the metal complex is a complex of  
20 rhodium with a compound having at least two diphenylphosphino groups as the ligand.

8. A metal complex-protein composite in accordance

with claim 6, wherein the metal complex has the ligand expressed by Formula (1):



where  $R^1$  through  $R^4$  represent any of completely  
5 identical, partially identical, and completely different  
substituted and non-substituted hydrocarbons of 1 to 10  
carbon atoms and substituted and non-substituted phenyls,  
and J represents any of substituted and non-substituted  
hydrocarbons of 1 to 10 carbon atoms and two carbon atoms  
10 included in benzene rings.

9. A hydrogenation catalyst, which is a metal  
complex-protein composite in accordance with claim 1 and  
works to accelerate hydrogenation of an olefin in water.